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THE SOUTHERN CORN ROOTWORM AND FARM PRACTICES TO CONTROL IT

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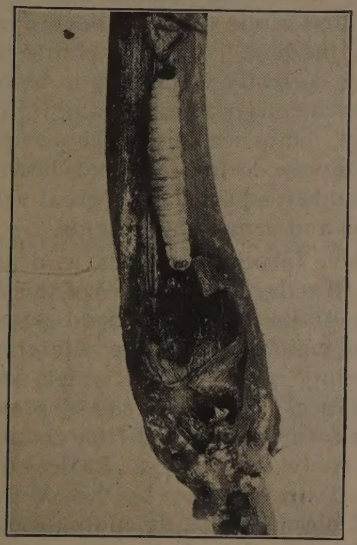

FARMERS' BULLETIN 950

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. May, 1918

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OF ALL CORN PESTS in the South one of the most serious is the larva, or young, of the 12-spotted cucumber beetle—the so-called southern corn rootworm. True to its name, it feeds on the roots, but in young corn it also drills a small hole in the stem just above the first circle of roots, boring out the crown and killing the bud. Attacked plants either die outright or are so badly stunted as to be unproductive. Lowland corn suffers the most and injury is greatest during cool, damp seasons. The adult, or beetle, is also exceedingly destructive; not, however, to corn, but to cucumber, squash, and a great variety of other truck crops and ornamental plants.

Progressive farming methods, as described in this bulletin, will reduce the ravages of this insect. Burn over waste places to destroy dead grass, weeds, and rubbish in which the beetles winter. If possible, avoid planting corn in fields which contained corn the year before. Enrich the soil by planting legumes so that the corn will have a better chance of recovering from rootworm injury. Protect the bobwhite. This bird destroys many beetles of the rootworm. By careful observations, extending over a period of years, find out the dates between which the rootworm does the most damage; then time your planting so that it will fall either before or after these dates, taking into consideration, of course, other important factors in crop production.

THE SOUTHERN CORN ROOTWORM[1] AND FARM PRACTICES TO CONTROL IT.

CONTENTS.

	Page.		Page.
Economic importance and common names	3	How the insect passes the winter	8
Geographical range of this and related rootworms	4	Number of generations annually	8
When serious infestations may be expected	4	Natural enemies	8
Injury to corn by the rootworm	5	Native birds	8
How injury to corn by the rootworm can be recognized	5	Insects	8
Development	6	Preventive and other control measures	9
Egg stage	6	Burning over waste places	9
Worm or larva stage and larval food plants	6	Crop rotation	9
Pupa or transformation stage	7	Thick planting	9
Parent or beetle stage and food habits of the beetle	7	Enriching the soil	10
		Timely planting	10

ECONOMIC IMPORTANCE AND COMMON NAMES.

CORN GROWERS in the Southern States suffer damage from the southern corn rootworm (fig. 1) practically every year. In fact, as a serious corn pest in the South the rootworm has few competitors. During some seasons it is quite a difficult matter to get a stand of corn in the lowlands on account of these worms. During years of heavy infestation it is necessary to replant corn as many as three times and even then only a poor stand is obtained. The loss that may be attributed to the ravages of the pest is probably even greater and more far-reaching than is commonly supposed. Very often weather conditions are blamed for the yellowish and sickly appearance of corn and the resulting poor yield of the crop, when in reality the true cause is southern corn rootworm injury.

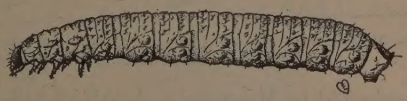

FIG. 1.—Southern corn rootworm: Larva or worm, side view. About four and one-half times natural size.

Although this rootworm sometimes damages the corn crop in the more northerly sections of the Middle West, it is not there considered a serious corn pest. A closely allied insect, the western corn rootworm,[2] takes its place as an enemy of corn in these regions.

[1] *Diabrotica duodecimpunctata* Olivier; order Coleoptera, family Chrysomelidae.

[2] *Diabrotica longicornis* Say.

The southern corn rootworm is more commonly known as the "budworm"; in fact, few farmers know it under the former name. It is sometimes termed "drillworm." These names are more or less descriptive of the injury done to the plant by the worms. The adult, or parent, is known as the 12-spotted cucumber beetle, from the fact that it has 12 black spots on its back and is often a serious enemy to cucumbers and allied plants.

GEOGRAPHICAL RANGE OF THIS AND RELATED ROOTWORMS.

The southern corn rootworm has a very wide distribution. It is found throughout the greater part of the United States from Maine to Florida, and from the Atlantic coast to the Rocky Mountains. It occurs also in Mexico and Canada. It is not recognized, however, as a serious pest of Indian corn north of Maryland and the southern parts of Ohio, Indiana, and Illinois, south of Georgia, or west of the Mississippi River, with the exception of parts of southeastern Texas and southern Louisiana. (Fig. 2.)

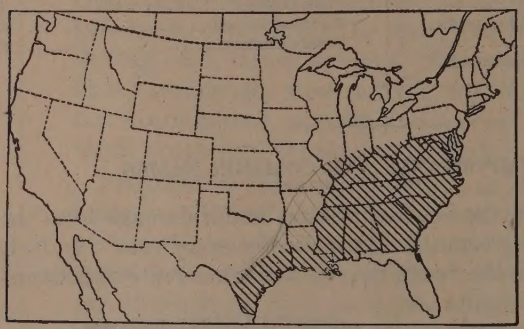

FIG. 2.—Map showing, by shaded area, region where corn is most seriously injured by the southern corn rootworm.

The western corn rootworm[1] occurs from Maine to the Gulf of Mexico and westward to Minnesota, South Dakota, and New Mexico.

In the States bordering the Pacific occurs a closely allied species.[2] This western rootworm is often injurious to various cultivated crops. In southern Texas there is still another species, the belted cucumber beetle,[3] which sometimes does practically as much damage to corn in that region as the southern corn rootworm.

WHEN SERIOUS INFESTATIONS MAY BE EXPECTED.

Serious infestations of the rootworm may be expected during seasons of abundant rainfall and cool weather, conditions conducive to the development of this insect. Corn in lowlands is more seriously affected than that in uplands, as this insect prefers to breed in moist soil. Thus it is only during years of heavy infestation that corn in uplands is subject to serious damage.

[1] *Diabrotica longicornis* Say. [2] *Diabrotica soror* LeConte. [3] *Diabrotica balteata* LeConte.

INJURY TO CORN BY THE ROOTWORM.

The worm or larva stage (fig. 1) of this insect is the one most injurious to corn. As the name "corn rootworm" would indicate, it feeds on the roots of corn, but it does not confine its injuries to the roots; indeed, the greatest damage to young corn is that done by the worms in drilling a small hole into the stem directly above the first circle of roots (see title-page illustration) and feeding on the

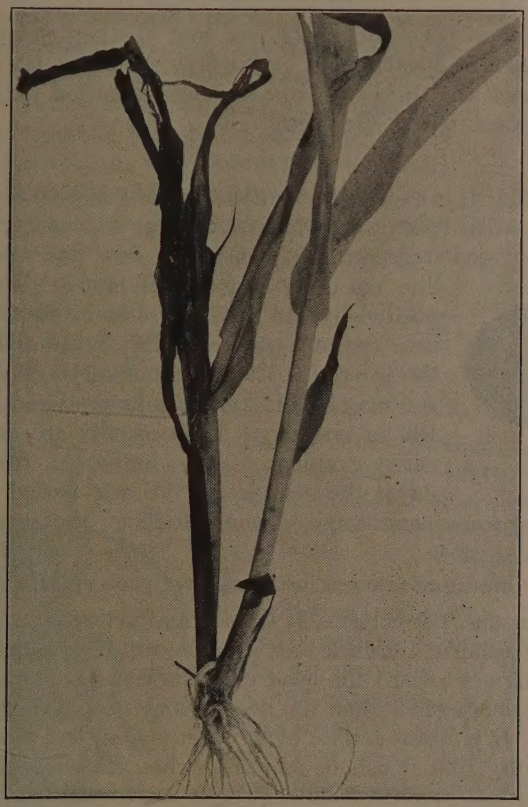

FIG. 3.—Corn plant showing injury by southern corn rootworm to growing point or "bud."

interior, boring out the crown and killing the bud. Plants affected in this way break off at the injured point when an attempt is made to pull them. In older corn the worms injure the roots almost exclusively.

HOW INJURY TO CORN BY THE ROOTWORM CAN BE RECOGNIZED.

When young corn has been damaged by this insect the fact can be easily detected. The bud leaves of injured plants, having been cut off from the main plant, dry up and die (fig. 3), while the rest

of the plant retains its original color for a time. Subsequently the whole plant dies if injured badly. It is on account of this peculiar manner of injury that the insect is often called the "budworm."

Larger plants when attacked present a sickly yellowish and dwarfed appearance, due to the fact that the worms are feeding on the roots. Very often such plants exhibit a number of suckers, and they produce little or no grain.

DEVELOPMENT.

The southern corn rootworm has four distinct stages through which it passes in development. The first is the egg, the second the worm or larva, the third the pupa or transformation stage, and the fourth the adult, parent, or beetle.

EGG STAGE.

The egg (fig. 4) is oval and about the size of a large pinhead. It is dull yellow when freshly laid, but later turns a deeper yellow. Its surface is covered with extremely small, shallow pits which in outline resemble a six-sided figure. Eggs are deposited by the female beetle in contact with or near the corn plants, slightly below the surface of the ground. Their number varies greatly. Over 400 may be laid by one individual and as many as 100 in one day. Eggs usually are deposited in early evening. They hatch in from 6 to 8 days, the length of the egg period depending upon temperature conditions. Upon hatching, the worms attack the stems and roots.

FIG. 4.—Southern corn rootworm: Egg greatly enlarged.

WORM OR LARVA STAGE AND LARVAL FOOD PLANTS.

The worm (fig. 1), or larva, is slender and yellowish-white, with a dark-brown head and a dark patch on the top of the last body segment. It tapers toward the head end, the last few segments of the body being much wider than the head, which makes them appear as if swollen. It is quite active, even when young, and it is only with great difficulty that it can be captured when crawling about in the soil. When just hatched from the egg it is so small that it is barely perceptible to the unaided eye, but when full grown it can be seen readily, as it is then about one-half inch in length.

Upon examining infested or injured corn the worms may be found in their tunnels or among the roots. Sometimes, however, they are found some little distance away from the injured plants, probably migrating to other corn plants in the same row.

In addition to corn the larvæ of this species are known to feed and live on the roots of Johnson grass, Southern chess,[1] wheat, millet, rye, young oats, and alfalfa.

[1] *Bromus unioloides.*

PUPA OR TRANSFORMATION STAGE.

After the worm is full grown it enters the ground to a depth varying from a few inches to a half foot or more, the actual depth depending upon the texture of the soil. It then makes a cell somewhat oval in outline and smooths it very evenly on the inside. Presently it begins to shorten, and after an interval of a few days it sheds its skin and passes into the pupa or transformation stage.

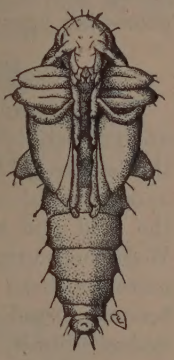

FIG. 5.—Southern corn rootworm: Pupa or resting stage. About eight times natural size

A clear conception of what the pupa is like can be formed by examining figure 5. In this stage the insect can not move from place to place and is not destructive. It never leaves its cell. The only part capable of movement is the tip of the abdomen, which is moved about violently when the pupa is disturbed. The pupa is soft, yellowish, and about one-fourth of an inch in length. It is a little longer than the width of its broadest part and has two very conspicuous spines at the tip of the abdomen.

The pupa stage lasts about 10 days and then the 12-spotted beetle, or parent, comes forth and works its way through the soil to the surface of the ground.

PARENT OR BEETLE STAGE AND FOOD HABITS OF THE BEETLE.

FIG. 6.—Southern corn rootworm: Adult or beetle. About eight times natural size.

The parent or beetle (fig. 6) is about one-fourth inch in length, yellowish-green, with a black head and legs and, as previously stated, with 12 black spots on the back. These spots are irregular in outline and generally somewhat separated.

The beetle is very active during warm weather and can be captured only with difficulty. When feeding, if danger threatens, it falls to the ground and crawls away under rubbish or hides under the foliage of smaller plants. During cool weather it becomes less active, and when the temperature is near freezing it scarcely moves, even when disturbed.

In the beetle stage the insect is quite destructive—not, however, to corn but to certain truck crops such as squashes, cucumbers, etc., and on account of the fact that it is such a serious enemy of these plants the beetle is known as the 12-spotted cucumber beetle. The injury to these plants consists of numerous small holes in the leaves, and if the

plants are small and have only a few leaves a great deal of harm is done unless preventive measures have been taken.

In relation to corn the beetle stage is important as being the egg-laying period of the insect, for the female, after having mated, places her eggs in the soil near the corn plants.

HOW THE INSECT PASSES THE WINTER.

The southern corn rootworm passes the winter in the beetle stage, except possibly in southern Florida and Texas. In northerly regions the beetles go into hibernation late in the fall; that is, they crawl under rubbish and to other places that afford them protection from the cold and remain in an inactive condition during the winter. With the return of warm weather they again become active. In the more southern States, where temperatures are mild, they do not become torpid in the winter, but during cool days and nights hide under rubbish, among dead grasses, or under low-leaved plants and resume activity when the weather again becomes warm. There are some native plants which remain green throughout the winter in the South and beetles have been found feeding on them, as well as on rye, oats, and other field crops, during warm days in midwinter.

NUMBER OF GENERATIONS ANNUALLY.

The exact number of generations of this species as yet has not been determined definitely for any one locality. There appear, however, to be at least two generations in the North and three in the South. As a pest of corn in the South the first two generations only need be considered, and as a rule most of the damage is done by the first generation of the year.

NATURAL ENEMIES.

NATIVE BIRDS.

A number of our native birds prey upon the adults, or beetles, of the southern corn rootworm. Some of the common ones are the bobwhite, red-headed woodpecker, nighthawk, cardinal, kingbird, and phœbe. Of these birds the bobwhite deserves special mention. As many as 12 of the beetles have been found in the stomach of one bobwhite.

INSECTS.

The southern corn rootworm has only a few insect enemies, the chief one being a two-winged fly[1] (fig. 7) which attacks it in the beetle stage. This fly places a maggot, or larva, in the abdomen of the beetle, and the maggot feeds on the vital organs of the host and finally kills it. After the death of the beetle the parasite larva, being full grown, enters the ground and forms a tough, leathery case

[1] *Celatoria diabroticae* Shimer.

in which it passes into the next or pupa stage. This case, termed puparium, is dark and covered with needlelike spines. From the puparium there emerges in due time the adult, or fly, which starts the cycle again. This parasite is not very common and thus far has not played a very great rôle in the destruction of the pest.

PREVENTIVE AND OTHER CONTROL MEASURES.

Although no one method has been discovered which, when applied, will eradicate this pest, yet if the following measures are diligently carried out the ravages of this insect can be reduced markedly.

BURNING OVER WASTE PLACES.

Large numbers of the beetles are destroyed by burning over waste places, such as the borders and terraces of fields. This should be done in the winter-time and on cool days. Beetles at that time and on such days congregate among dead grasses, seeking protection from cold. The value of this measure is realized when one considers that the killing of one female in winter is as important as the destruction of from 400 to 500 worms in the spring.

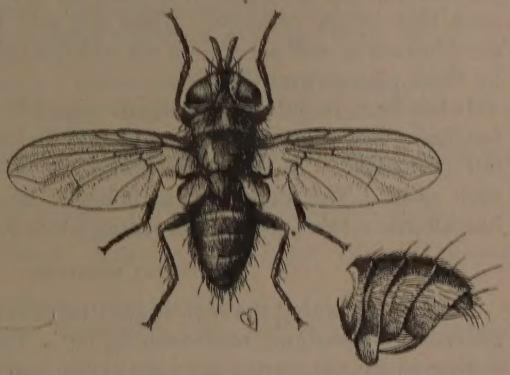

FIG. 7.—A fly enemy of the southern corn rootworm. At the right is shown the piercer by means of which the fly deposits a maggot within the adult or beetle of the rootworm. Fly about eight times natural size.

CROP ROTATION.

Judicious crop rotation should be carried on wherever possible. It is not well to follow corn with corn. There are several crops that are not injured by these worms, the foremost of them being cotton. Some of the smaller grains are only slightly injured and can, therefore, be used to good advantage in the rotation.

THICK PLANTING.

It is a common practice among some of the planters in the southeastern States who are acquainted with rootworm injury to plant corn thicker in the lowlands than in the uplands. Double the number of grains are dropped in low ground. This offers twice the chance of securing a stand and is to be recommended especially for fields which consist partly of low ground. The upland in such cases may be

planted in the regular way. In fields of large area this measure loses its value, for if planted thickly some thinning may be necessary and this may mean a loss of labor, time, and money.

ENRICHING THE SOIL.

It is to be remembered that soil rich in plant food will produce plants that are more hardy, healthy, and capable of resisting insect attack than soil which is not so supplied. Plants injured by the "budworms" sometimes recover and the chances are that a larger percentage will do so in rich than in poor soil. Legumes should rank high in the rotation. They will add to the soil the much desired humus as well as store in the soil the valuable nitrogen extracted by these plants from the air.

It has been found that lowlands supplied abundantly with animal fertilizers are more seriously affected by these worms than those not so treated. It is well to make use of commercial fertilizers in such cases. This does not, as believed by some, repel the insects, but affords a less favorable breeding place for the pest.

TIMELY PLANTING.

The time at which the corn is planted affects, to a certain extent, its likelihood of escaping rootworm injury. There seems to be a period during which the worms are very active and do much damage. This period varies considerably with the latitude, being somewhat earlier in the extreme South than in more northerly regions. It has been found that corn planted during the latter part of March and after May 10 is less damaged than is that planted during April and the first week in May. There were exceptions, as some corn planted in late March and after May 10 suffered badly, but the largest acreage of injured corn was planted between the dates given.

In each locality, also, these periods naturally will vary somewhat from year to year depending upon the seasonal weather conditions. Every farmer, however, by careful observation extending over a period of years may discover when planting should take place so as to minimize the ravages of this pest, taking into account, of course, other important factors in crop production.

Investigations are now being conducted, in cooperation with the State entomologists of North Carolina and Florida, with a view to the determination of the importance of the time of planting as a factor in "budworm" control.

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